7. Water Quality Data

7.1. Introduction

7.1.1. The Seattle District Corps of Engineers Hydrology and Hydraulics Section (COE) is conducting a baseline water quality assessment of fish hatchery water sources at Chief Joseph Dam during the 2004 water year. Potential sources of water identified for this study include the relief tunnel, the irrigation inlet structure located near the right bank in the forebay, and the orientation water system wells located along the right bank at the hatchery site. The fish hatchery would utilize one or more of these sources of water during the entire year to meet the quantity and quality of water needed for hatchery operations.

7.1.2. The quality of the proposed hatchery source water is important because water quality can determine the success or failure of fish hatchery operations. Physical and chemical characteristics of the source waters must be properly analyzed and evaluated in order to select a suitable water source. Historical sampling conducted in 1989 and 1990 at the relief tunnel and hatchery site wells detected mercury at concentrations exceeding Washington State Department of Fish and Wildlife (WDFW) recommended water quality criteria for aquaculture programs. Recent sampling conducted in 2003 detected mercury at concentrations well below WDFW recommended criteria but did detect nitrite at concentrations exceeding the WDFW recommended criteria. Consequently, the Colville Tribes expressed concerns about the quality of the relief tunnel and orientation water system wells water for hatchery operations. To address these concerns, the COE designed a water study to quantify more precisely the water quality of all potential water sources for the fish hatchery.

7.2. Purpose and Scope

7.2.1. The purpose of the study is to characterize the quality of the relief tunnel, hatchery site wells and forebay waters during the winter, spring, summer, and fall to determine if these waters are of sufficient quality for use at a fish hatchery. The objective of the monitoring program is to determine existing water quality conditions of possible hatchery source waters during a water year. These objectives will be met using data collection and analysis methods to evaluate surface water quality and ground water quality at Chief Joseph Dam.

7.2.2. This study is currently being conducted during 2004 and has not been completed. Data were collected on February 3, 2003 from one (1) station in the relief tunnel and one (1) station in the forebay. Data were not collected at the hatchery site well during the February sampling event because the well was decommissioned for the winter and was not operational. Therefore, the data presented in this section are preliminary and represent only one sampling event out of a possible four sampling events. It is anticipated that additional samples, including the hatchery site well, will be collected in the spring and/or summer.

7.3. Methods

7.3.1. Site Characterization

7.3.1.1. Chief Joseph Dam is located at river mile 545 on the Columbia River in Washington, about 51 miles downstream of Grand Coulee Dam (Figure 1). The dam is a concrete gravity dam, 230 feet high, with 19 spillway bays which abut the right bank. The general location of the irrigation inlet structure, the relief tunnel, and the hatchery site wells are shown in Figure 2.

7.3.1.2. The irrigation inlet structure is located on the face of the dam near the right bank at a depth of about 30 feet below the forebay water surface under normal pool conditions. The relief tunnel extends over 1,000 feet from the northwest end of the spillway into the right abutment. Access to the tunnel is by way of galleries in the interior of the dam. The tunnel captures water seeping from the forebay through the right bank and towards the right abutment. Water drains into the tunnel via wood stave wells located in the floor of the tunnel, flows down the tunnel into a sump located near the foot of the gallery stairs, and ultimately drains to the Columbia River via a 4-foot conduit. The hatchery site wells are located on the right bank of the river about 3,500 feet downstream of the dam near the site of the proposed fish hatchery. These wells are located at a distance from the river of about 50 feet and an elevation above the river of about 20 feet.

7.3.2. Data Collection

7.3.2.1. Sampling procedures were conducted according to the *Preliminary Scope of Work: Water Quality Sampling at Chief Joseph Dam for the Colville Tribes Fish Hatchery* (USCOE 2003), and generally followed Puget Sound Estuary Program (PSEP) protocols (U.S. EPA 1990). Water quality parameters monitored in the relief tunnel and forebay are shown in Table 1. Sampling locations are presented in Figure 2. As previously noted, water quality was not monitored at the hatchery site wells because they were not operational during the sampling event. Prior to the sampling event, all sampling equipment was thoroughly cleaned and decontaminated following PSEP protocols. The equipment was scrubbed with a brush and detergent (1 percent Liquinox), thoroughly rinsed with deionized water, rinsed with a 10 percent Nitric Acid solution, and given a final rinse with deionized water.

7.3.2.2. Surface water grab samples were collected from the center of the channel in the relief tunnel and from a depth of 30 feet in the forebay by field technicians wearing new vinyl gloves. Relief tunnel samples were collected by submerging laboratory-cleaned, prelabled sample containers below the water surface to a depth of about 1 foot. Forebay samples were collected from a depth of 30 feet by submerging a cleaned and decontaminated 2.2 liter (L) polycarbonate (Lexan) van-dorn style sampler with ultra-clean seals to depth and filling. All sample containers were rinsed 3 times prior to filling, capped, and immediately placed on ice in a cooler. Measurements of field parameters (See Table 1) were performed by submerging a Hydrolab DataSonde 4

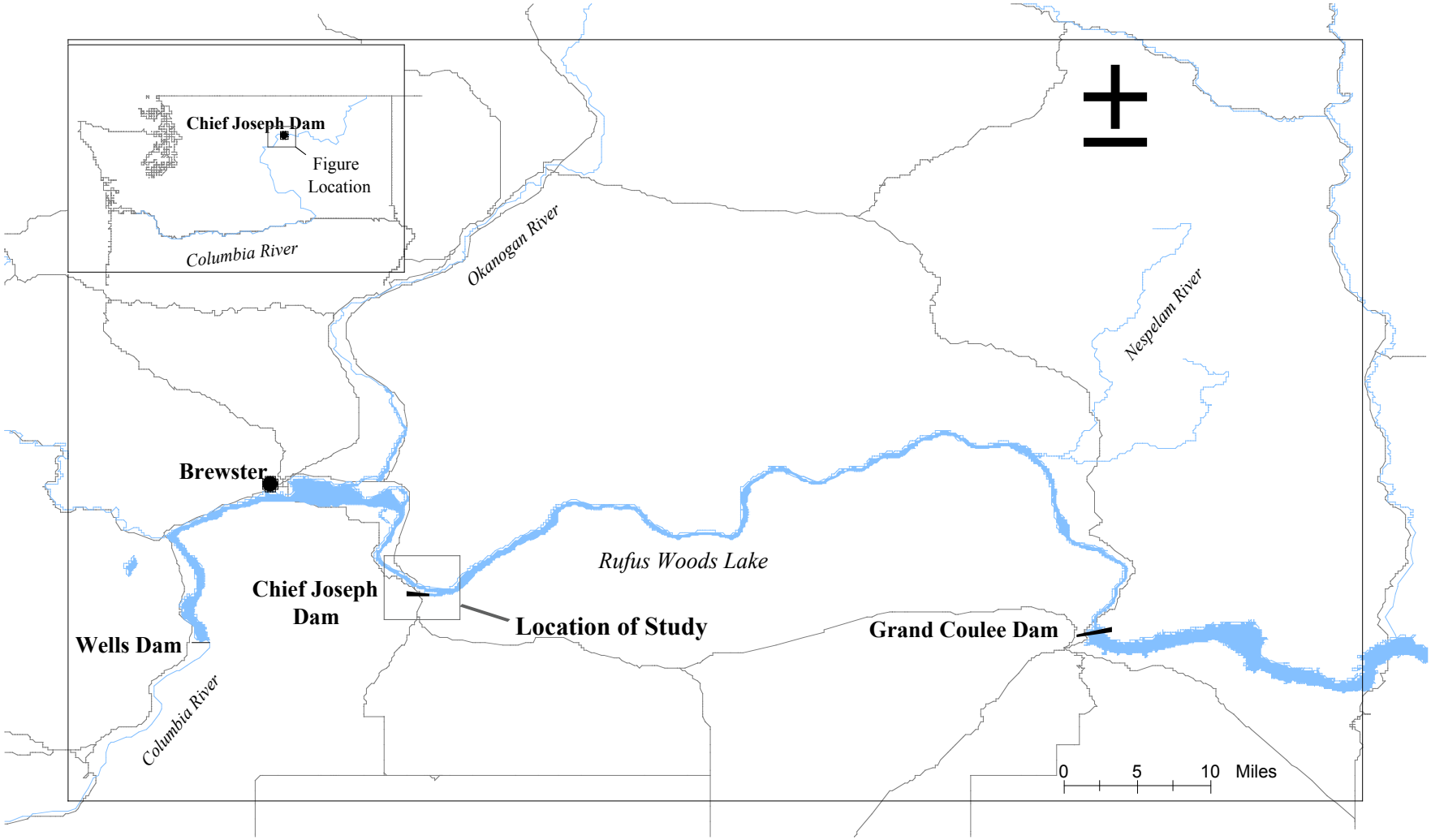

Figure 1. Location of the study.

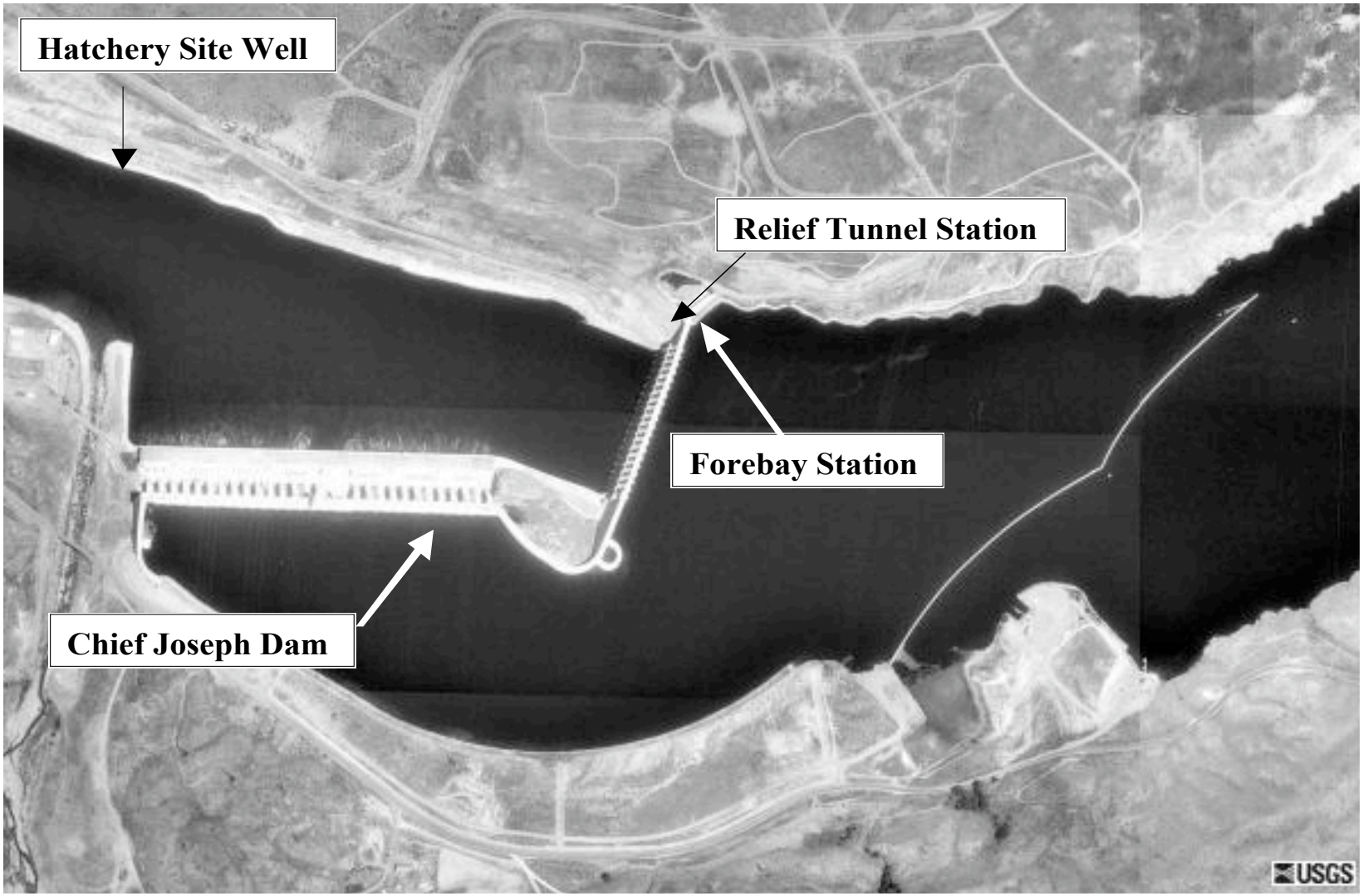

Figure 2. Location of the water quality sampling stations.

Table 1. Methods and detection limits for water quality analyses.

	Matrix	Method Number [a]	Detection Limit/Unit
Field Parameters			
Temperature	Water	SM 2550-B	0.1°C
pH	Water	SM 4500-H	–
Conductivity	Water	SM 2510-B	1 µS/cm
Turbidity	Water	SM 2130-B	0.1 NTU
Dissolved Oxygen	Water	SM 4500-O-G	0.1 mg/L
Laboratory Parameters			
Total Phosphorus	Water	AM 4500PB	0.010 mg/L
Total Nitrogen	Water	EPA 351.2	0.100 mg/L
Nitrate+Nitrite	Water	EPA 353.2	0.010 mg/L
Nitrite	Water	EPA 354.1	0.010 mg/L
Ammonia	Water	EPA 350.1	0.010 mg/L
Alkalinity	Water	EPA 310.1	1.00 mg/L
Hardness	Water	SM182340B	1.00 mg/L
Calcium	Water	EPA 6010	0.100 mg/L
Magnesium	Water	EPA 6010	0.100 mg/L
Potassium	Water	EPA 6010	0.700 mg/L
Sodium	Water	EPA 6010	0.500 mg/L
Sulfate	Water	EPA 300	1.00 mg/L
Chloride	Water	EPA 300	0.50 mg/L
Fluoride	Water	EPA 300	0.100 mg/L
Aluminum	Water	EPA 200.8	0.020 mg/L
Arsenic	Water	EPA 200.8	0.002 mg/L
Barium	Water	EPA 200.8	0.005 mg/L
Cadmium	Water	EPA 200.8	0.0002 mg/L
Chromium	Water	EPA 200.8	0.0020 mg/L
Copper	Water	EPA 200.8	0.0010 mg/L
Iron	Water	EPA 200.8	0.020 mg/L
Lead	Water	EPA 200.8	0.0010 mg/L
Manganese	Water	EPA 200.8	0.005 mg/L
Mercury	Water	EPA 1631B	0.0020 µg/L
Nickel	Water	EPA 200.8	0.0020 mg/L
Selenium	Water	EPA 200.8	0.0030 mg/L
Silver	Water	EPA 200.8	0.0010 mg/L
Zinc	Water	EPA 200.8	0.005 mg/L
Total Dissolved Solids	Water	EPA 160.1	5.00 mg/L
Pesticide/PCB	Water	EPA 8081/8082	0.005 µg/L to 0.1 µg/L

[a] SM method numbers are from APHA et al. (1992); EPA method numbers are from U.S. EPA (1983, 1984).
mg/L Milligrams per liter
µS/cm Microsiemens per centimeter
NTU Nephelometric turbidity unit

multiprobe directly into the forebay water or from a sample withdrawn from the relief tunnel. Equipment used for field measurements was calibrated prior to the sampling event. One set of field duplicates was collected at the forebay station to assess both environmental and analytical variability. All samples were transported to the laboratory within 24 hours, where they were analyzed for the parameters shown in Table 1.

7.3.3. Quality Assurance Procedures

7.3.3.1. Quality assurance of water quality samples followed procedures set forth in the *Preliminary Scope of Work: Water Quality Sampling at Chief Joseph Dam for the Colville Tribes Fish Hatchery* (USCOE 2003). Data were validated according to the sampling and analysis plan, and quality control data provided by the laboratory were combined with results of field duplicates to check the precision and accuracy of the data. Data validation results are presented in Attachment A at the end of this report. Values qualified as estimates were used in the evaluation, and none of the values were rejected.

7.3.4. Water Quality Criteria

7.3.4.1. The Washington Department of Ecology (WDOE) and the Colville Tribes determine surface water quality criteria for the Columbia River at Chief Joseph Dam in Washington. The WDOE has classified the Columbia River above and below Chief Joseph Dam as a Salmon and Trout spawning non-core rearing and migration aquatic life use water body, while the CCT has classified the Columbia River as a Class I water body above Chief Joseph Dam and a Class II water body below the dam. These criteria are designed for the protection of aquatic life in fresh surface waters of the state of Washington and the Colville Reservation. However, at the time of this report, water quality criteria for regulating source waters intended for aquaculture do not exist for the state of Washington. In lieu of aquaculture specific criteria, WDFW has compiled a list of recommended water quality criteria for source waters intended for aquaculture uses as shown in Table 2. For comparative purposes, WDOE surface water chronic criteria are also shown in Table 2.

7.3.5. Historical Data

7.3.5.1. Historical water quality data for the relief tunnel, forebay, and hatchery site well are presented in Table 3. Data collected in 1977 by Koch and Cochran (1977) from the relief tunnel and forebay are limited and represent only field parameters and conventionals. Relief tunnel samples were collected near the lower end of the tunnel, while forebay samples were collected from the surface about 50 feet upstream of the dam. Data collected by the COE between 1989 and 2003 represent the most complete data set for these water sources. Samples from the relief tunnel, forebay, and hatchery site well were analyzed for field parameters, conventionals, metals and bacteria. Relief tunnel samples were collected near the lower end of the tunnel about 15 feet upstream of the sump while forebay samples were collected from the surface about 50 feet upstream of the dam.

Table 2. Washington State Department of Fish and Wildlife Recommended Water Quality Criteria for Aquaculture and Ecology Chronic Criteria.

Parameter	Units	WDFW Recommended Values		WDOE Values [b]
		Piper Values [a]	U.S. EPA Values [a]	
Alkalinity (as $CaCO_3$)	mg/L	10 – 40	At least 20	
Aluminum	mg/L	< 0.01		
Ammonia (as NH_3)	mg/L	0.0125	0.02	0.028[c]
Arsenic	mg/L	< 0.05		0.19
Barium	mg/L	< 5.0		
Cadmium (Alk > 100 mg/L)	mg/L	< 0.0004	0.0004	0.0009[b]
Cadmium (Alk < 100 mg/L)	mg/L		0.003	
Calcium Carbonate	mg/L	4 – 160		
Carbon Dioxide	mg/L	0 – 10		
Chloride	mg/L	< 4.0		230
Chlorine	mg/L	< 0.03	0.003	0.011
Chromium	mg/L	< 0.03	0.03	0.1483[b]
Copper (Alk > 100 mg/L)	mg/L	< 0.006	0.006	0.0094[b]
Copper (Alk < 100 mg/L)	mg/L		0.03	
Fluoride	mg/L	< 0.5		
Hardness	mg/L	10 – 400		
Hydrogen Cyanide	mg/L	< 0.01		0.0052
Hydrogen Sulfate	mg/L	< 0.0001	0.002	
Iron	mg/L	< 0.15		
Lead	mg/L	< 0.03	0.03	0.0020[b]
Manganese	mg/L	< 0.01		
Mercury	µg/L	< 0.2	0.2	0.012
Nickel	mg/L	< 0.01		0.1302[b]
Nitrate	mg/L	0 – 3		
Nitrite	mg/L	< 0.1		
Nitrogen	% sat	< 100		110
PCBs	mg/L	< 0.002	0.002	0.00014
pH	units	6.5 – 8.0	6.0 – 9.0	6.5-8.5
Potassium	mg/L	< 5.0		
Salinity	ppt	< 5.0		
Selenium	mg/L	< 0.01		0.005[d]
Settleable Solids	mg/L	< 80	< 80	
Silver	mg/L	< 0.003		0.0024[b]
Sodium	mg/L	< 75		
Sulfate	mg/L	< 50		
Total Dissolved Solids	mg/L	10 – 1000		
Total Suspended Solids	mg/L	< 80	< 80	
Uranium	mg/L	< 0.1		
Vanadium	mg/L	< 0.1		
Zinc	mg/L	< 0.03		0.0865

a Sources: Piper et al (1982) and U.S. EPA (1973).
b Dissolved metals chronic criteria for waters with an average hardness of 80 mg/L, except Silver, which is an acute criteria.
c. Based on a typical pH value of 7.8 and a water temperature of 10°C.
d. Total recoverable fraction.

Table 3. Summary of historical water data collected in the relief tunnel, forebay and hatchery well at Chief Joseph Dam.

	Historical Data	Historical Data	Historical Data	Historical Data	Historical Data	Historical Data	Historical Data	Historical Data	Historical Data
	Relief Tunnel (1/19/1977)[1]	Relief Tunnel (4/14/1989)[2]	Relief Tunnel (5/26/1989)[2]	Relief Tunnel (1/29/2003)[2]	Relief Tunnel (5/13/2003)[2]	Forebay (1/19/1977)[1]	Forebay (1/29/2003)[2]	Forebay (5/13/2003)[2]	Hatchery Well (9/19/1990)[2]
Field Parameters									
Temperature (°C)	_	_	_	_	_	_	_	_	_
PH	87.7	_	_	_	_	7.67	_	_	_
Conductivity (µS/cm)	162	170	_	161	_	141	138	_	270
Turbidity (NTU)	□	0.4	_	< 0.5	_	□	< 0.5	_	0.2
Conventionals/Bacteria									
Nitrate+Nitrite (mg/L)	□	_	_	0.32	_	□	0.4	_	_
Nitrate (mg/L)	0.75	0.3	_	0.16	_	0.49	0.21	_	2.5
Nitrite (mg/L)	_	_	_	**0.16**	_	□	**0.19**	_	_
Alkalinity (mg/L)	_	_	_	_	_	□	_	_	_
Hardness (mg/L)	88.5	80	_	72.9	_	72.7	67.2	_	120
Calcium (mg/L)	22.3	_	_	21	_	20.2	19.5	_	_
Magnesium (mg/L)	5.3	_	_	4.97	_	4.3	4.5	_	_
Potassium (mg/L)	1.5	_	_	_	_	0.65	_	_	_
Sodium (mg/L)	2.4	< 5	_	2.18	_	1.5	1.46	_	< 10
Sulfate (mg/L)	9.8	_	_	8.4	_	11.5	8.9	_	_
Chloride (mg/L)	0.5	< 5	_	< 0.5	_	0.5	< 0.5	_	< 5
Fluoride (mg/L)	_	< 0.2	_	0.15	_	□	0.12	_	< 0.2
Total Dissolved Solids (mg/L)	86.1	_	_	64	_	75	382	_	_
Total Coliform Bacteria (#/100mL)	_	_	_	< 2	_	_	< 2	_	_
Fecal Coliform Bacteria (#/100mL)	_	_	_	< 2	_	_	< 2	_	_

Table 3. Summary of historical water data collected in the relief tunnel, forebay and well at Chief Joseph Dam (Continued).

	Historical Data	Historical Data	Historical Data	Historical Data	Historical Data	Historical Data	Historical Data	Historical Data	Historical Data
	Relief Tunnel (1/19/1977)[1]	Relief Tunnel (4/14/1989)[2]	Relief Tunnel (5/26/1989)[2]	Relief Tunnel (1/29/2003)[2]	Relief Tunnel (5/13/2003)[2]	Forebay (1/19/1977)[1]	Forebay (1/29/2003)[2]	Forebay (5/13/2003)[2]	Hatchery Well (9/19/1990)[2]
Dissolved Metals									
Arsenic (mg/L)	□	< 0.010	_	< 0.002	_	□	< 0.002	_	< 0.010
Barium (mg/L)	□	< 0.250	_	0.014	_	□	0.043	_	< 0.250
Cadmium (mg/L)	□	< 0.002	_	< 0.0003	_	□	< 0.0003	_	< 0.002
Chromium (mg/L)	□	< 0.010	_	< 0.0047	_	□	< 0.0047	_	< 0.010
Copper (mg/L)	□	< 0.250	_	< 0.002	_	□	< 0.002	_	< 0.250
Iron (mg/L)	□	< 0.100	_	0.0124	_	□	0.013	_	< 0.100
Lead (mg/L)	□	< 0.002	_	< 0.0005	_	□	< 0.0005	_	< 0.002
Manganese (mg/L)	□	<0.010	_	< 0.002	_	□	< 0.002	_	<0.010
Mercury (µg/L)	□	**0.6**	**0.6**	**< 0.3**	0.000171	□	**< 0.3**	0.000365	**0.5**
Nickel (mg/L)	□	_	_	< 0.010	_	□	< 0.010	_	_
Selenium (mg/L)	□	< 0.005	_	< 0.005	_	□	< 0.005	_	< 0.005
Silver (mg/L)	□	< 0.010	_	< 0.0047	_	□	< 0.0047	_	< 0.010
Zinc (mg/L)	□	< 0.250	_	< 0.020	_	□	< 0.020	_	< 0.250

1. Source: Koch and Cochran (1977)
2. Source: USCOE (2004)

mg/L Milligrams per liter
µg/L Micrograms per liter
□S/cm Microsiemens per centimeter
NTU Nephelometric turbidity unit
< Analyte not detected at specified detection limit
□ Not analyzed/not available

0.001 Value Exceeds Washington State Department of Fish and Wildlife Recommended Criteria for Aquaculture (Piper et al. 1982; U.S. EPA 1973)

7.3.5.2. Little difference in water quality for the relief tunnel, forebay, and hatchery site well was observed between samples collected in 1977, 1989, 1990, and 2003 except for mercury. Mercury was detected in the relief tunnel and hatchery site well in 1989 and 1990 at concentrations exceeding both the WDFW recommended criteria and the WDOE chronic criteria. Sampling at both sites on January 29, 2003 had a mercury detection limit above the WDFW and WDOE criteria, so re-sampling occurred on May 13, 2003 using a lower detection limit. The May 13, 2003 samples detected mercury in the relief tunnel and forebay at concentrations well below the WDFW and WDOE criteria. The WDFW criteria for nitrite was exceeded in the relief tunnel and forebay samples on January 29, 2003, with forebay nitrite concentrations (0.19 mg/L) slightly greater that relief tunnel concentrations (0.16 mg/L). Nitrate concentrations were relatively low. No other exceedances of the WDFW or WDOE water quality criteria were observed from the historical data.

7.4. Results and Discussion

7.4.1. Water quality results are shown in Table 4. In general, water quality at the relief tunnel and forebay locations were good with no exceedances of either the WDFW recommended criteria for aquaculture or the WDOE chronic criteria. Field parameters monitored include temperature, conductivity, pH, dissolved oxygen, and turbidity. These parameters show little difference between the relief tunnel sample and the forebay sample except for conductivity and dissolved oxygen. Relief tunnel water had a higher conductivity and lower dissolved oxygen concentration than the forebay, likely reflecting the influence of chemical interactions between the surface water and the overlying soil and bedrock along the right bank. Temperature was not recorded in the relief tunnel.

7.4.2. Conventional parameters data indicate that the relief tunnel water quality is similar in quality to the forebay water, with only minor differences. Slightly greater alkalinity, hardness, calcium, potassium, sodium, and total dissolved solids concentrations in the relief tunnel suggest that chemical interactions between the forebay water seeping into the right bank and the overlying soil and bedrock may be occurring. The overall similarity in water quality between the relief tunnel and forebay suggest that the major source of water to the relief tunnel is the forebay. However, the slightly greater concentrations of several major ions together with the observed differences in conductivity and dissolved oxygen could also indicate that another source of water, possibly ground water derived from local precipitation, is influencing the relief tunnel water quality.

7.4.3. Four forms of nitrogen were sampled, total kjeldhal nitrogen (TKN), nitrate + nitrite-nitrogen ($NO_3 + NO_2$), nitrite (NO_2), and ammonia nitrogen ($NH_4^+ + NH_3$). The dissolved inorganic forms of nitrogen, ammonia and nitrate + nitrite are all readily available for plant growth. Total kjeldhal nitrogen includes ammonia plus organic nitrogen, while nitrate + nitrite-nitrogen represents total oxidized nitrogen, with nitrite being an intermediate state between ammonia and nitrate. Nitrate is an essential plant nutrient, while nitrite can be a plant nutrient but is toxic to animal life and is generally rapidly oxidized to nitrate in oxygenated waters.

Table 4. Summary of current water data collected in the relief tunnel, forebay and hatchery well at Chief Joseph Dam.

	CHJRT Relief Tunnel (2/3/2004)	CHJFB Forebay (2/3/2004)
Field Parameters		
Temperature (°C)	□	2.7
PH	7.7	7.8
Conductivity (µS/cm)	157	135
Turbidity (NTU)	0.3	1.0
Dissolved Oxygen (mg/L)	6.9	10.5
Conventionals		
Total Phosphorus (mg/L)	0.031	0.016
Total Kjeldahl N (mg/L)	< 0.2	< 0.2
Nitrate+Nitrite (mg/L)	0.14	0.15
Nitrate (mg/L)	0.14	0.15
Nitrite (mg/L)	< 0.01	< 0.01
Ammonia (mg/L)	0.017	< 0.01
Alkalinity (mg/L)	74	63
Hardness (mg/L)	66	67
Calcium (mg/L)	19.0	18.7
Magnesium (mg/L)	4.61	4.86
Potassium (mg/L)	1.4	0.7
Sodium (mg/L)	2.3	1.8
Sulfate (mg/L)	8.9	9.6
Chloride (mg/L)	0.9	1.0
Fluoride (mg/L)	< 0.1	< 0.1
Total Dissolved Solids (mg/L)	99	68
Dissolved Metals		
Aluminum (mg/L)	< 0.02	< 0.02
Arsenic (mg/L)	0.0011	0.0004
Barium (mg/L)	0.015	0.025
Cadmium (mg/L)	< 0.0002	< 0.0002
Chromium (mg/L)	< 0.0005	< 0.0005
Copper (mg/L)	< 0.0005	0.0006
Iron (mg/L)	< 0.02	< 0.02
Lead (mg/L)	< 0.001	< 0.001
Manganese (mg/L)	< 0.001	< 0.001
Mercury (µg/L)	0.000118 E	0.000256 E
Nickel (mg/L)	0.0005	0.0007
Selenium (mg/L)	< 0.005	< 0.005
Silver (mg/L)	< 0.0005	< 0.0005
Zinc (mg/L)	< 0.006	< 0.006

Table 4. Summary of current water data collected in the relief tunnel, forebay and hatchery well at Chief Joseph Dam (Continued).

	CHJRT Relief Tunnel (2/3/2004)	CHJFB Forebay (2/3/2004)
PCBs (µg/L)		
Aroclor 1016	< 0.1	< 0.1
Aroclor 1242	< 0.1	< 0.1
Aroclor 1248	< 0.1	< 0.1
Aroclor 1254	< 0.1	< 0.1
Aroclor 1260	< 0.1	< 0.1
Aroclor1221	< 0.1	< 0.1
Aroclor 1232	< 0.1	< 0.1
Pesticides (µg/L)		
alpha-BHC	< 0.0062 E	< 0.0052 E
beta-BHC	< 0.0062 E	< 0.0052 E
delta-BHC	< 0.0062 E	< 0.0052 E
gamma-BHC (Lindane)	< 0.0062 E	< 0.0052 E
Heptachlor	< 0.0062 E	< 0.0052 E
Aldrin	< 0.0062 E	< 0.0052 E
Heptachlor Epoxide	< 0.0062 E	< 0.0052 E
Endosulfan I	< 0.0062 E	< 0.0052 E
Dieldrin	< 0.012 E	< 0.010 E
4,4'-DDE	< 0.012 E	< 0.010 E
Endrin	< 0.012 E	< 0.010 E
Endosulfan II	< 0.012 E	< 0.010 E
4,4'-DDD	< 0.012 E	< 0.010 E
Endosulfan Sulfate	< 0.012 E	< 0.010 E
4,4'-DDT	< 0.012 E	< 0.010 E
Methoxychlor	< 0.062 E	< 0.052 E
Endrin Ketone	< 0.012 E	< 0.010 E
Endrin Aldehyde	< 0.012 E	< 0.010 E
gamma Chlordane	< 0.0062 E	< 0.0052 E
alpha Chlordane	< 0.0062 E	< 0.0052 E
Toxaphene	< 0.62 E	< 0.52 E

mg/L Milligrams per liter
µg/L Micrograms per liter
□S/cm Microsiemens per centimeter
NTU Nephelometric turbidity unit
E Estimated value
< Analyte not detected at specified detection limit
□ Not analyzed/not available

0.001 Value Exceeds Washington State Department of Fish and Wildlife Recommended Criteria for Aquaculture.

7.4.4. Ammonia nitrogen is largely produced by the deamination of organic nitrogen-containing compounds and is a plant nutrient that is often utilized before nitrate. Ammonia is generally reported as the combined ionized (NH_4^+ -ammonium) and unionized (NH_3-ammonia) forms of ammonia. However, only the unionized form of ammonia (NH_3) is toxic to freshwater life and this form of ammonia has water quality criteria established (See Table 2). Equations can be used to estimate the concentration of unionized ammonia fraction from measured values of the pH and temperature of the water.

7.4.5. Nitrate concentrations were similar between the relief tunnel and forebay, while ammonia was only detected in the relief tunnel at very low concentrations (0.017 mg/L). Using an average unionized ammonia percentage of 1.8 percent in pH 8.0 water at 10 °C (APHA 1992), the calculated unionized ammonia is 0.00003 mg/L, which is well below WDFW and WDOE criteria. In general, chronic ammonia toxicity is not a problem in pH 8.0 water at 10 °C when ammonia-nitrogen concentrations are less than about 2 mg/L (EPA 2002). The greater ammonia concentrations and the slightly lower nitrate concentrations in the relief tunnel versus the forebay may be due to oxidation-reduction conditions in the ground water favoring the presence of ammonia. Nitrite was not detected in the relief tunnel or forebay samples.

7.4.6. Dissolved metals did not exceed the WDFW recommended criteria for aquaculture or the WDOE chronic criteria during the sampling event. Concentrations were below the laboratory detection limits for all metals except barium and mercury, which were detected at very low concentrations in the relief tunnel and forebay. Mercury concentrations in the relief tunnel (0.000118 µg/L) were similar to concentrations detected on May 13, 2003 (0.000171 µg/L) and well below concentrations detected in 1989 (0.6 µg/L). Similarly, concentrations in the forebay (0.000256 µg/L) were similar to concentrations detected on May 13, 2003 (0.000365 µg/L). These data suggest that mercury concentrations in the relief tunnel water may not be a water quality concern for the fish hatchery. However, it is recommended that additional samples be collected during the spring and summer to determine if any seasonal variations in mercury concentrations occur in the relief tunnel and forebay.

7.4.7. Polychlorinated biphenyls (PCBs) were not detected at the relief tunnel and forebay on the sampling date at the laboratory detection limits shown in Table 4. These detection limits are below the WDFW recommended criteria for aquaculture but are greater the WDOE chronic criteria. Therefore, exceedances of the WDOE chronic criteria may have occurred in non-detected samples.

7.4.8. Chlorinated pesticides were not detected at the relief tunnel and forebay on the sampling date at the laboratory detection limits shown in Table 4. There are no WDFW recommended criteria for pesticides. However, these detection limits are below the WDOE chronic criteria, resulting in no exceedances of the WDOE chronic criteria.

7.5. Conclusions

7.5.1. Water quality samples collected from the relief tunnel and forebay during the February 3, 2004 sampling event were characterized by good water quality with no exceedances of the

WDFW recommended criteria for aquaculture or the WDOE chronic criteria for surface waters. It should be noted that the detection limits for PCBs and some pesticides exceeded the WDOE criteria suggesting that exceedances may have occurred in non-detected samples. Historical exceedances of mercury and nitrate measured in the relief tunnel were not seen for the current sampling event. Water quality samples were not collected from the hatchery site well during the February sampling event due to the well being non-operational during the winter months.

7.5.2. It is recommended that water quality samples be collected at the relief tunnel, forebay, and hatchery well site in the spring and summer to determine if any seasonal variations in water quality exist for these source waters. Because mercury and nitrate were historically detected in these source waters at concentrations exceeding the WDFW recommended criteria for aquaculture, it is advised to sample water quality more than one time before concluding that these source waters are acceptable for the fish hatchery. In addition, the hatchery well site should be sampled in the spring and summer to determine the existing water quality conditions of this potential hatchery source water.

7.6. References

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Attachment A

7.7. Quality Assurance Report

7.7.1. This report presents results from the quality assurance review of data collected for the Libby Dam Ground Water Quality Monitoring Project. Data assessment procedures used in this quality assurance review are based on the following eight control elements:

Completeness
Methodology
Holding times
Detection limit
Blanks
Duplicates
Matrix spikes
Control samples.

7.7.2. No major problems were associated with the data collected in connection with this project. The following sections provide specific details for each of the quality control elements reviewed and any resultant corrective action required.

7.7.3. Completeness

7.7.3.1. Completeness was assessed by comparing valid sample data values with total number of sample values. Because the number of valid sample data divided by the total number of samples was greater than the quality assurance objective of 95 percent, no corrective actions were required to address problems related to completeness.

7.7.4. Methodology

7.7.4.1. Methodology was assessed by examining field notebooks, sampling data sheets, and laboratory reports for deviations from the monitoring plan and quality assurance plan. Subsequent to this review, it was concluded that there were no significant deviations in methodology that required corrective action.

7.7.5. Holding Times

7.7.5.1. Holding times were assessed by comparing analytical dates to sample collection dates. Corrective action was implemented for all values that exceeded the maximum holding times required by U.S. EPA. Holding time problems were encountered for pesticide samples collected on 2/3/04 from all sites because the samples were extracted beyond the required 7-day holding time. Data qualified as an estimate (E).

7.7.6. Blanks

7.7.6.1. Preparation blanks, which are composed of reagent water that is prepared as a sample, were analyzed with collected samples, and the results were reported in each laboratory report. If a blank value exceeded the detection limit, corrective actions were to be implemented for the associated samples. Mercury was detected in the method blank, resulting in sample values that were less than 5 times the detected blank being considered estimates (E).

7.7.7. Detection Limits

7.7.7.1. Laboratory data were reported with a method detection limit (MDL) and a reporting detection limit (RDL). The laboratory MDL represents the minimum concentration of a constituent that can be detected. All data values that were below the MDL were qualified as below detection with a < symbol next to the reported detection limit.

7.7.8. Duplicates

7.7.8.1. Laboratory duplicates are two aliquots of a sample processed concurrently and identically. Corrective action was implemented for all laboratory duplicates with a relative percent difference (RPD) greater than 20 percent. No duplicate problems were encountered.

7.7.9. Matrix Spikes

7.7.9.1. Matrix spikes are used as an indicator of matrix effects on sample recovery and precision. If a percent recovery from a matrix spike was not within 80 to 120 percent for conventionals and metals or a pre-determined laboratory range for organics, corrective actions were implemented where necessary. No matrix spike problems were encountered.

7.7.10. Control Samples

7.7.10.1. Control samples refer to check standards, blank spikes, or standard reference materials. If the percent recovery for a control standard was not within 80 to 120 percent for conventionals and metals, and a pre-determined laboratory range for organics, corrective actions were implemented, where necessary. All control sample recoveries were within acceptable limits.